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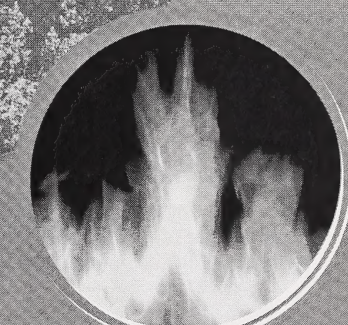
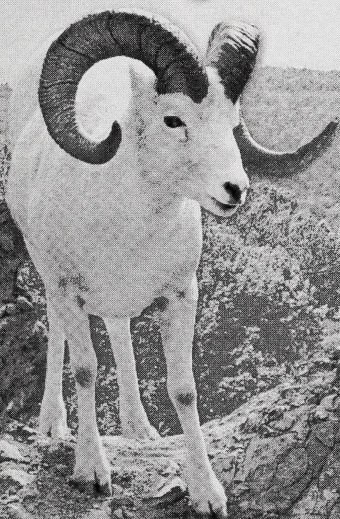
# SCIENCE 9

Module

3

## Environmental Chemistry

*Home Instructor's Guide  
and Assignment Booklet 3B*



Learning  
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Branch

Alberta  
LEARNING



Science 9  
Module 3: Environmental Chemistry  
Home Instructor's Guide and Assignment Booklet 3B  
Learning Technologies Branch  
ISBN 0-7741-2588-8

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**The Learning Technologies Branch acknowledges with appreciation the Alberta Distance Learning Centre and Pembina Hills Regional Division No. 7 for their review of this Home Instructor's Guide and Assignment Booklet.**

This document is intended for	
Students	✓
Teachers	✓
Administrators	
Home Instructors	✓
General Public	
Other	



You may find the following Internet sites useful:

- Alberta Learning, <http://www.learning.gov.ab.ca>
- Learning Technologies Branch, <http://www.learning.gov.ab.ca/ltb>
- Learning Resources Centre, <http://www.lrc.learning.gov.ab.ca>

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## Section 2: The Problem of Pollution

In this section the student discovers the role of chemistry in assessing what substances are pollutants. The student identifies pollution sources, assesses water quality, and uses techniques of environmental monitoring. The student applies this knowledge along with risk assessment concepts in decision-making. The decision-making involves issues related to pollution and waste management.

The following materials will be needed to complete this section.

### Section 2: Lesson 1

- safety goggles
- an apron
- latex gloves
- eight clean plastic drinking glasses of the same shape and size
- a marking pen
- a spoon
- a ruler
- salt
- sugar

### Section 2: Lesson 2

No extra materials are needed for this lesson.

### Section 2: Lesson 3

No extra materials are needed for this lesson.

### Section 2: Lesson 4

No extra materials are needed for this lesson.

## Suggested Answers

### Section 2: Lesson 4

Textbook questions 1, 4, 7, 9, and 11 of “Wrap-up: Topics 4 to 6,” page 253:

1. Pollution is material or energy added to the environment in large enough concentrations to cause harm to organisms or their habitat.
4. Macroinvertebrates are large enough to be easily collected, identified, and studied. Sensitivity to pollutants varies from species to species. They live and eat in the water, and their populations have been proven to correlate with water quality.
7. Heat energy is considered to be a pollutant when it is added to the natural environment in large enough quantities to cause harm to organisms or their habitat. Temperature changes can cause reproductive problems and alterations to oxygen and chemical concentrations in the water. Each species has a range of tolerance for temperature. If this range is exceeded, the species will do poorly or die out.



9. Recycling reduces the overall demand for energy, water, and materials. It reduces the amount of pollution generated in the production of goods, and it decreases the amount of material that must be stored in a landfill.
11. Mercury is used in fluorescent light bulbs as “ballast.” Since mercury is a heavy metal with toxic characteristics, the light bulbs that contain mercury become hazardous waste when they are discarded.

## Module Review

### 1. Textbook questions 1, 4, 5, 8 to 11, 15, 19, 20, 25, and 33 from “Understanding Key Concepts,” pages 258 to 260:

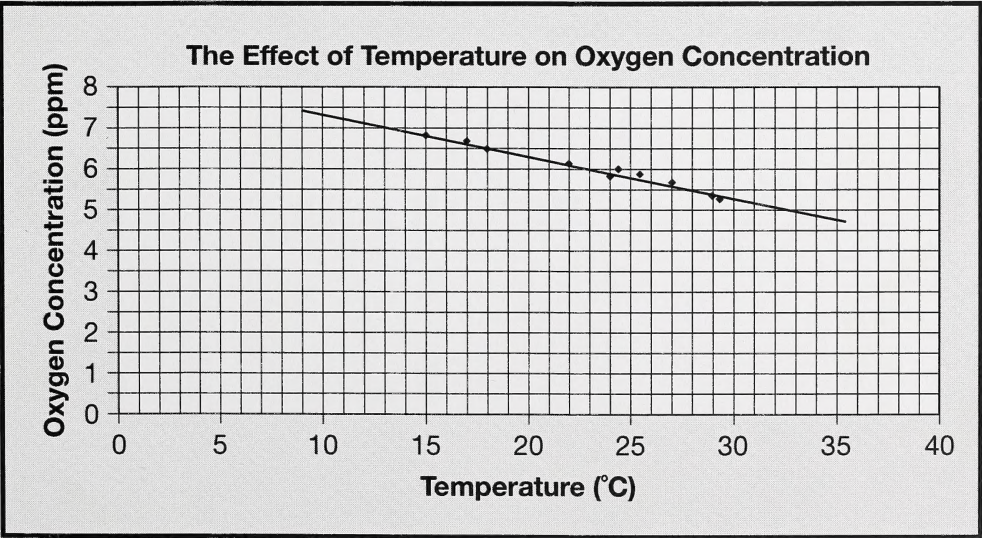
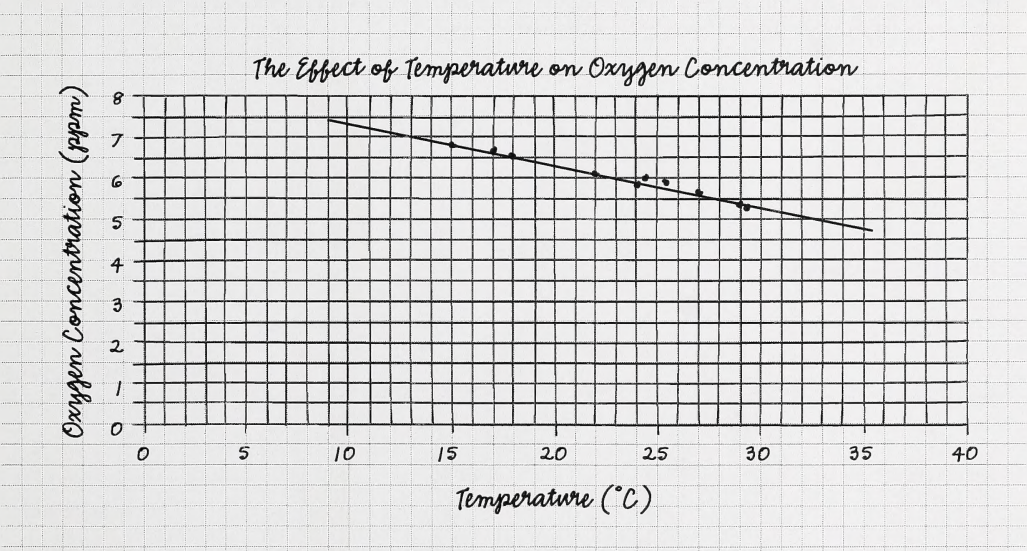
1. Each of these elements is required for bone formation.
4. Plants bioaccumulate minerals from their substrate. These essential nutrients are then passed on to animals.
5. Bacteria in the soil decompose dead matter or waste matter to make the nutrients available for plant growth. Bacteria also convert nitrogen into compounds that plants can use (nitrogen fixation).
8. Fungicides are used to control fungi, herbicides control weeds, and insecticides control insects.
9. DDT was a cheap and effective chemical for killing disease-bearing and crop-damaging insects. It was considered to be a safe chemical when it was introduced.
10. DDT is a stable, non-excretable toxin that bioaccumulates in organisms and biomagnifies through the food web. Its breakdown product, DDE, is now considered to be a toxin as well. DDT is still in use in several developing countries.
11. A poison causes illness or death when it's absorbed or ingested. Toxins are protein molecules, produced by organisms, that cause illness or death. Not all poisons are toxins. *Toxic* refers to the result (illness or death), not to the chemical causing the result. The term *toxic* can therefore be applied to the results produced by both poisons and toxins.
15. Sulfur oxides released by industry and transport react with water in the atmosphere to produce sulfuric acid ( $\text{H}_2\text{SO}_4$ ) and sulfurous acid ( $\text{H}_2\text{SO}_3$ ). Nitrogen oxides produce nitric acid ( $\text{HNO}_3$ ) and nitrous acid ( $\text{HNO}_2$ ). Carbon dioxide produces carbonic acid ( $\text{H}_2\text{CO}_3$ ).
19. Eastern Canada is most affected by acid precipitation. It is the most industrialized area, and it is located downwind of major manufacturing areas in the United States. Eastern Canada is located on the inert rocks and soils of the Canadian Shield, which is not naturally buffered by limestone.
20. Catalytic converters are used on cars to decrease the amount of nitrogen oxides and carbon monoxide released by burning fossil fuel. The converters facilitate more complete fuel combustion—this decreases the release of acid precipitation precursors and carbon particulates.
25. Non-persistent pollutants are relatively easy to biodegrade into non-toxic breakdown products.
33. Global wind and water currents carry pollutants into polar regions. Cold temperatures slow or prevent their breakdown, which allows more time for the pollutants to biomagnify through the food web.



2. a. Here is a checklist that can be used to assess student graphs:

- The graph has a specific title.
- The graph is in pencil or is computer generated.
- Lines (such as axes) are straight.
- The  $x$ -axis is labelled and the units are printed.
- The  $y$ -axis is labelled and has printed units.
- The  $x$  and  $y$  axis scales are appropriate.
- Data is placed appropriately on the grid.
- The line of best fit is included properly.

Student graphs should be similar to one of the following graphs. The second graph is made by a computer spreadsheet.



- b. As the water temperature increases, the oxygen concentration in the water decreases.
- c. Answers will vary somewhat. The value is read from the line of best fit. Based on interpolation, the oxygen concentration at 20° C would be 6.3 ppm.
- d. Answers will vary somewhat. The value is again read from the line of best fit, which may have to be extended. Based on extrapolation, the oxygen concentration at 9° C would be 7.5 ppm.
- e. Yes, there is a very strong relationship between water temperature and oxygen concentration. All the data points are near to the line of best fit.

**Note:** Dissolved oxygen does not refer to the oxygen atom in each water molecule. The oxygen atoms within water molecules are not available for “breathing.” The dissolved oxygen in water is actually composed of a very small number of molecules. How small is this number? There are at most just 10 molecules of oxygen interspersed among every million molecules of water. This dissolved form of oxygen is what is available to aquatic organisms.



# ASSIGNMENT BOOKLET 3B

Science 9

Module 3: Section 2 Assignment and Final Module Assignment

Home Instructor's and Student's Comments:

**STUDENT FILE NUMBER**

(if label is missing or incorrect)

Date Submitted:

Apply Module Label Here

Name

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*Please verify that preprinted label is for  
correct course and module.*

**FOR SCHOOL USE ONLY**

Assigned Teacher:

Date Assignment Received:

Grading:

Teacher's Comments

Teacher's Signature

Home Instructor: Keep this sheet when it is returned to you as a record of the student's progress.

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When you are registered for distance learning courses, you are expected to regularly submit completed assignments for correction. Try to submit each Assignment Booklet as soon as you complete it. Do not submit more than one Assignment Booklet in one subject at the same time. Before submitting your Assignment Booklet, please check the following:

- Are all the assignments completed? If not, explain why.
- Has your work been reread to ensure accuracy in spelling and details?
- Is the booklet cover filled out and the correct module label attached?

## MAILING

1. Do **not** enclose letters with your Assignment Booklets. **Send all letters in a separate envelope.**
2. Put your Assignment Booklet in an envelope and take it to the post office and have it weighed. Attach **sufficient postage** and seal the envelope.

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2. All faxing costs are the responsibility of the sender.

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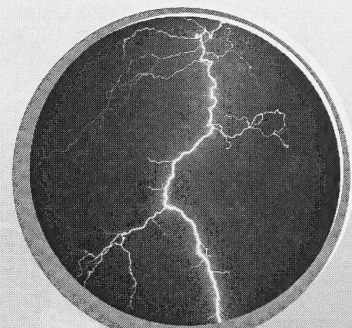


# SCIENCE 9

Module

3

## Environmental Chemistry *Assignment Booklet 3B*



Learning  
Technologies  
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Alberta  
LEARNING



## FOR TEACHER'S USE ONLY

### Summary

	Total Possible Marks	Your Mark
Section 2 Assignment	37	
Final Module Assignment	70	
	107	

### Teacher's Comments

Science 9

Module 3: Environmental Chemistry

Assignment Booklet 3B

Section 2 Assignment and Final Module Assignment  
Learning Technologies Branch

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**ASSIGNMENT BOOKLET 3B**  
**SCIENCE 9: MODULE 3**  
**SECTION 2 ASSIGNMENT AND FINAL MODULE ASSIGNMENT**

Your mark for this module will be determined by how well you do your assignments.

This Assignment Booklet is worth 107 marks out of the total 173 marks for the assignments in Module 3. The value of each assignment and each question is stated in the left margin.

Work slowly and carefully. If you have difficulty, go back and review the appropriate topic.

Be sure to proofread your answers carefully.

**Section 2 Assignment: The Problem of Pollution**

**Read all parts of your assignment carefully and record your answers in the appropriate places.**

- 37
- 3 1. Some students debated the issue of putting chlorine in water. In your opinion, is chlorinating water worth the cancer risk? Support your opinion.

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- 2 2. Is a dioxin concentration of 0.04 ppm below the LD50 standard? Explain.

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- 3 3. Some people feel that “dilution is the solution to pollution.” Could toxins found in air, water, or soil in concentrations well below LD50 ever become very harmful to you or other organisms? Explain.

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Answer questions 4 to 6 by using the information and data supplied for “Inquiry Investigation 3I: Testing Water Quality” in Section 2: Lesson 2 of the Student Module Booklet.

Refer to the corresponding investigations on pages 225 to 229 of the textbook as well.

3

4. Was the tested fertilizer meant to grow leaves, roots, or flowers? Explain.

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5. Refer to all the pond water data.

1

- a. Would you consider the water to be polluted?

---

- b. Provide three specific measured data values to support your opinion. Include units. For each data value, interpret whether it is high or low. Also indicate any effect on aquatic life.

1

- data value:

---

2

interpretation/effect:

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---

1

- data value:

---

2

interpretation/effect:

---

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1

- data value:

---

2

interpretation/effect:  

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6. The amount of dissolved oxygen in a body of water would be affected by any of the following:
- an increase in the water temperature
  - an increase in the surface area of the water in contact with air
  - an increase in the number of plants in the water
  - an increase in the number of animals in the water

2

a. Which of these changes would lead to a decrease in dissolved oxygen?  

---

---


2

b. Which of these changes would lead to an increase in dissolved oxygen?  

---

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 Return to page 47 of the Student Module Booklet and continue with Lesson 2.



1

7. Refer to both the data table and the drawing on page 235 of the textbook. You will see the number of organisms detected along a stream. Use this information to answer the following questions.

a. Classify the water at site C as high quality, medium quality, or low quality. Explain.  

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①

- b. Aquatic worms are tolerant of low oxygen conditions. Site E has a fairly high population of aquatic worms. Do you consider site E to be polluted? Explain.

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②

- c. Consider the populations of dragonfly nymphs at sites C and D. A set of rapids is located between these two sites. Explain the difference in the dragonfly populations at these two sites.

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①

- d. It has been determined that both the sewage outlet and the agricultural areas along the river basin contribute to the river's water quality. What is the major difference between these two sources?

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Return to page 51 of the Student Module Booklet and continue with Lesson 3.

②

8. Could the people living a traditional lifestyle in the high Arctic be classified as bioindicators of industrial pollution? Explain.

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①

9. Name a pollutant that attacks the ozone layer.

---

①

10. Why is the ozone layer important to living things?

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2

11. A grade 9 student was describing her science class to her younger brother. She spoke about pollutants spreading in the environment. Her brother suggested a simple way to get rid of waste liquids, such as used motor oil and paint thinners. He suggested that such liquids should simply be thrown out in a pit and allowed to seep into the ground.

Give two reasons why this would not be a good idea.

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1

12. Circle the letter of the correct response.

Most of the hazardous organic substances found in households are

- A. salts
- B. solvents
- C. sugars
- D. solids

Return to page 61 of the Student Module Booklet and continue with the Module Summary.

70

Final Module Assignment

Read all parts of your assignment carefully and record your answers in the appropriate places.

1

1. The use of chlorofluorocarbons (CFCs) has been banned around the globe for many years. Explain why the ozone layer is still thinning.

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3

2. "The dose, the time period, and the individual determine the toxicity." Explain this phrase.

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- ① 3. It is usually a bigger problem when a point source discharges into ground water than it is when a point source discharges into surface water. Explain why.
- 
- 
- ① 4. Warnings on the labels of many types of glue advise you to avoid skin contact with the glue, and they also advise you to use the glue in a well-ventilated area. Explain why these warnings are necessary.
- 
- 
5. Excessive runoff from fields and feedlots affects the populations of the caddis fly larvae and gilled snails in a nearby stream.
- ① a. What would happen to the populations of these two species as a result of this excessive runoff?
- 
- 
- ① b. What environmental factor would cause the population changes? Be specific.
- 
- 
- ① c. Name the chain of events that would lead to the change in this environmental factor.
- 
- ② 6. Coastal towns and cities often release untreated household sewage and industrial sewage directly into the ocean. Briefly describe two natural mechanisms that would reduce the resulting pollution.
- 
- 
- 
-



2

7. Water quality tests can play an important part in assessing the level of pollutants in the environment. Provide two reasons why testing water quality can be particularly useful to determine environmental health.
- 
- 
- 
- 

8. Everyone is responsible for some pollution.

2

- a. Name two different, common activities that contribute to surface water pollution.
- 
- 

1

- b. What could you do to prevent or reduce one of these pollution sources?
- 
- 

2

9. Determine how much solanine a 60 kg person would have to consume to risk a 50% chance of death. **Remember:** 1 ppm is equivalent to 1 mg/kg. Show your work including units.



10. Refer to the data table on page 260 of the textbook. Read the information in the paragraph above the table. The information shows the relation between the number of resistant species and the number of insecticides in use. Data was recorded in the given area for over 40 years.

- 12
- a. Graph both sets of data on the same axes. Place the year on the horizontal axis and the number on the vertical axis. Be sure to meet all the appropriate graphing criteria.


- 3
- b. As the years of insecticide use increase, the number of resistant species \_\_\_\_\_ and the number of insecticides in use \_\_\_\_\_.
- \_\_\_\_\_. The number of resistant species changes at a \_\_\_\_\_ rate than the number of insecticides in use.

- 1
- c. What is likely the reason for the difference in the rate of change?



3

- d. Do you think it is better to use chemical pesticides or genetically altered bacteria to fight these pests? Back your opinion with two specific reasons.

**Opinion:**

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**One reason:**

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**Your other reason:**

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2

11. The recommended daily allowance for zinc is 12 to 25 mg per day. Consuming 150 mg or more zinc per day can cause a copper deficiency. Some manufacturers recommend using zinc lozenges to soothe a sore throat, at a rate of about 13 mg of zinc every two hours. Explain why using this recommended dosage of zinc throat lozenges could lead to anemia, which is a low red blood cell count.

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3

12. Your lawn is looking less healthy than it has for several years. Your neighbour offers to give you his bag of 7-7-15 fertilizer. Should you accept his offer based on what fertilizer would help your lawn? Explain.

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2

13. There has been a large spill of sulfuric acid into a lake. A week later, tests show that the pH of the lake is nearly normal. What could make these results possible?

**Reason 1:**

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**Reason 2:**

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4

14. Polychlorinated biphenyls (PCBs) are stable, non-excretable, fat-soluble toxins. Your local government has proposed building a high-temperature incineration plant for PCBs and similar chemicals. The plant would process chemicals from western Canada and the United States.

Provide two reasons in favour of building this plant and two reasons against. The reasons must be specific, and each one must be different.

**Pro 1:**

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**Pro 2:**

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**Con 1:**

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**Con 2:**

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①

15. "Any chemical is safe if it is consumed in small enough doses." Explain why this statement is incorrect.

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⑤

16. Explain what LD50 is and describe how it relates to the development of pesticide resistance.

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17. Use these scientific terms to answer the following questions.

- |                 |                 |                                  |
|-----------------|-----------------|----------------------------------|
| • aquifer       | • dispersal     | • impermeable                    |
| • permeable     | • leachate      | • nitrates and E. coli           |
| • surface water | • ground water  | • pesticides and plant nutrients |
| • transpire     | • sand          | • sulfur and nitrogen oxides     |
| • clay          | • bioaccumulate | • are diluted                    |

The following statements relate to the process of pollution in the environment. Fill in each answer blank with one given term to make the sentences meaningful. Note that not all the terms are used.

①

- a. The rate of \_\_\_\_\_ of a chemical in ground water is affected by soil porosity, soil type, rock type, and slope.

- ② b. A(An) \_\_\_\_\_ results from ground water being held above a layer of \_\_\_\_\_ material.
- ② c. \_\_\_\_\_ is the polluted liquid that flows downward through a landfill. In order to keep this liquid out of ground water, the landfill must be lined with \_\_\_\_\_.
- ① d. Untreated household sewage contains \_\_\_\_\_ as pollutants.
- ③ e. The run-off from agricultural land likely contains \_\_\_\_\_ . Some of these pollutants combine with \_\_\_\_\_ to cause algal blooms. Others enter the food chain and \_\_\_\_\_ to harmful levels.
- ① f. \_\_\_\_\_ enter the water cycle to form acid rain.
- ③ 18. Classify the following solutions as acid, base, or neutral.
- a. pH 9.3 \_\_\_\_\_ b. pH 1.5 \_\_\_\_\_
- c. pH 2.5 \_\_\_\_\_ d. pH 6.9 \_\_\_\_\_
- e. pH 7.0 \_\_\_\_\_ f. pH 12.5 \_\_\_\_\_
- ③ 19. List the solutions in question 18 from the most basic to the most acidic.
- \_\_\_\_\_

**Submit your completed Assignment Booklet 3B to your teacher for assessment.**



## ASSIGNMENT BOOKLET DECLARATIONS

The school you are registered with may require you to submit this signed form with your Assignment Booklet.

The Student's Declaration is to be signed by the student. If the student is under 16, the Supervisor's Declaration may need to be signed by the supervisor, who is usually a home instructor, teacher, or home-schooling coordinator. Failure to complete this page may invalidate the assignment results. Please contact your school and ask if this completed form is required.

### STUDENT'S DECLARATION

- I have followed the instructions outlined in the Student Module Booklet.
- I have completed the activities to prepare myself for the assignments in this Assignment Booklet.
- I completed the assignments in this Assignment Booklet by myself.

\_\_\_\_\_  
Student's Signature

### SUPERVISOR'S DECLARATION

I hereby certify that I have supervised the learning activities completed by \_\_\_\_\_.  
Student's Name

I also certify that to the best of my knowledge the assignments in this Assignment Booklet were completed independently by this student.

\_\_\_\_\_  
Supervisor's Signature

If you, the student or supervisor, have any comments or observations regarding this module, write them in the following space.

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the first of these is the need to ensure that the curriculum is relevant to the needs of the students. This involves a careful analysis of the current and future needs of the industry and the community. The second is the need to ensure that the curriculum is challenging and stimulating for the students. This involves the use of a variety of teaching and learning strategies, including problem-based learning, case studies, and group work. The third is the need to ensure that the curriculum is up-to-date and reflects the latest developments in the field. This involves regular review and revision of the curriculum.

### Curriculum Development Process

The curriculum development process is a continuous and iterative one. It begins with a needs analysis, which identifies the current and future needs of the students and the community. This is followed by the selection of the content to be taught, which is based on the needs analysis and the current state of the field. The next step is the development of the teaching and learning materials, which are designed to deliver the content in a way that is engaging and effective. Finally, the curriculum is implemented and evaluated, with the results used to inform future development.

### Curriculum Evaluation and Improvement

Curriculum evaluation is a critical part of the curriculum development process. It involves the collection and analysis of data on the effectiveness of the curriculum in meeting its goals. This data can be collected through a variety of methods, including student surveys, focus groups, and classroom observations. The results of the evaluation are used to identify areas for improvement and to inform the development of the next iteration of the curriculum.

There are a number of factors that can influence the effectiveness of the curriculum, including the quality of the teaching and learning materials, the quality of the teaching and learning environment, and the quality of the teaching and learning process.

One of the most important factors is the quality of the teaching and learning process. This involves the use of a variety of teaching and learning strategies, including problem-based learning, case studies, and group work. The quality of the teaching and learning process can be improved through the use of a variety of methods, including professional development, peer review, and self-reflection.

Another important factor is the quality of the teaching and learning environment. This involves the physical and social environment in which the teaching and learning takes place. The quality of the teaching and learning environment can be improved through the use of a variety of methods, including facility improvements, policy changes, and cultural change.

Finally, the quality of the teaching and learning materials is an important factor. This involves the use of a variety of teaching and learning materials, including textbooks, articles, and videos. The quality of the teaching and learning materials can be improved through the use of a variety of methods, including peer review, self-reflection, and professional development.

In conclusion, the curriculum development process is a continuous and iterative one. It involves the selection of the content to be taught, the development of the teaching and learning materials, the implementation of the curriculum, and the evaluation and improvement of the curriculum. The quality of the teaching and learning process, the quality of the teaching and learning environment, and the quality of the teaching and learning materials are all important factors that can influence the effectiveness of the curriculum.